

WHAT IS CLAIMED IS:

1. A method for detecting, tracking and locating submarines in water, comprising the steps of:
 - projecting monochromatic coherent radiation into a water column;
 - detecting reflections from particles in the water column to generate speckle patterns; and,
 - deducing from a change in the speckle patterns the presence of a submarine.
2. The method of Claim 1, wherein the monochromatic radiation is generated by a double pulse laser.
3. The method of Claim 2, wherein the pulses from the double pulse laser are separated by 10-100 microseconds.
4. The method of Claim 1, wherein the speckle patterns are detected using an array of detectors.
5. The method of Claim 1, wherein the speckle patterns are detected using an array of intensified detectors.
6. The method of Claim 1, wherein the speckle patterns are detected by an array of detectors selected from the group consisting of CCD and APD arrays.
7. The method of Claim 2, and further including the step of range gating the pulses from the double pulse laser so as to determine the depth of the detected submarine.

8. The method of Claim 1, and further including the step of cross-correlating the speckle patterns.
9. The method of Claim 2, wherein successive laser pulses produce separate speckle patterns and further including the step of utilizing dual pixel registered cameras for the detection of the two speckle patterns.
10. The method of Claim 2, wherein successive laser pulses produce separate speckle patterns and wherein the detecting step includes the step of utilizing a fast readout array for detecting returns from the two laser pulses.
11. The method of Claim 1, and further including the step of deducing from a change in speckle patterns the direction of travel of a submarine.
12. The method of Claim 1, and further including the step of deducing the direction of travel of a submarine from successive detections of the submarine at successive locations.
13. The method of Claim 1, and further including the step of deducing the direction of travel of a submarine from the level of decorrelation of the speckle patterns.
14. Apparatus for the detection of a subsurface vessel, comprising
a double pulse laser located above the sea surface and generating a collimated double pulse output;

laser beam direction-determining optics for projecting the collimated double pulse output of said laser through the air/sea interface to illuminate a water column;

at least one detector array for detecting sub-sea returns from particles in said water column so as to produce sequential speckle patterns corresponding to the arrival of the sequential pulses reflected from said particles; and,

a cross-correlator coupled to said sequential speckle patterns for cross-correlating said speckle patterns to generate a signal indicative of the degree of decorrelation of said successive speckle patterns, whereby decorrelation above a predetermined threshold is indicative of a subsurface vessel moving through the water.

15. The apparatus of Claim 14, and further including a range gate coupled to said detector array for activating said array at a predetermined delay time with respect to the generation of said double pulse output, said predetermined delay determining what segment of said water column is probed and the depth thereof.

16. The apparatus of Claim 15, wherein said range gate is set to exclude reflected returns from the air/sea interface.

17. The apparatus of Claim 14, wherein said double pulse laser includes a Nd:YAG laser.

18. The apparatus of Claim 14, wherein the spacing between said double pulses is between 10 and 100 microseconds.

19. A method for ascertaining the presence of a submersed vessel moving through a body of water, comprising the steps of:
- illuminating the surface of the water with the output of a double pulsed laser;
 - detecting returns from particles in the water caused to move by the wake produced by the submersed vessel to form a speckle pattern for each returned pulse;
 - cross-correlating successive speckle patterns produced from returns from successive laser pulses; and,
 - determining from the average decorrelation of the speckle patterns the presence of the submersed vessel.
20. The method of Claim 19, and further including the step of determining the direction of travel of the submersed vessel from the cross-correlation step.
21. The method of Claim 19, and further including the steps of flying the double pulse laser in a predetermined pattern so as to successively illuminate different portions of the surface of the water at known locations, and determining from the locations at which the subsurface vessel is detected, the track of the submersed vessel.
22. The method of Claim 21, and further including the step of determining how far the submersed vessel is from the illuminated portion by the level of decorrelation detected.
23. The method of Claim 19, and further including range gating the returns to detect the depth of the wake produced by the submersed vessel.